THE EFFECT OF ACUPUNCTURE ON CHRONIC PAIN IN DOGS SUFFERING FROM HIP DYSPLASIA AND OSTEOARTHRITIS – SUBJECTIVE ASSESSMENTS

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1 INTRODUCTION

Osteoarthritis (OA) has been ranked the most common cause of chronic pain among British veterinarians and other veterinary specialists (Bell et al. 2014) and studies suggest that 15 to 20 % of the whole canine population is likely to suffer from it (Johnston 1997, Lavrijsen et al. 2014). It is known that untreated pain reduces the quality of life and prolongs recovery, so pain management has become a very important part of veterinary medicine (Hellyer et al. 2007). Canine hip dysplasia (CHD) is a very common cause of OA, especially affecting older dogs and large dog breeds. The abnormal development of the coxofemoral joint in CHD results in subluxation, or even complete luxation, of the femoral joint and eventually OA (Fossum 2013). CHD results from a combination of hereditary and environmental factors (Fossum 2013) and there is continuous effort to eradicate it from the canine population. Still, we have dog breeds with very high occurrence of CHD. For example, 98 % of English Bulldogs, 74 % of French Bulldogs, 72 % of Bullmastiffs, 43 % of Bernese Mountain Dogs and 39 % of Golden Retrievers that have been born during this century, have been diagnosed with moderate (Doig et al. 2000) or severe CHD (Official statistics of the Finnish Kennel Club 2000-2015).

Since there is no cure for CHD and OA, the goal is usually to prevent the disease progression, to treat the pain that OA causes and to improve the quality of life of the dogs suffering from the disease Surgery and pain medication are the treatments usually used for CHD, but since they don't apply to all, we try to find new treatment options. Non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used and efficient for the treatment of chronic pain caused by CHD and OA (Grubb 2010b), but they can have many adverse effects, especially in long term use. NSAIDs can, for example, cause gastrointestinal symptoms, bleeding disorders, and liver or kidney problems, and thus they cannot be used for dogs suffering from kidney or liver dysfunction or gastrointestinal problems (Duncan et al. 2005). Opioids are also commonly used to treat chronic pain, but they might not be as effective as NSAIDs against inflammatory pain and they can also cause side effects, such as sedation and constipation (Grubb 2010). Surgery is also an option if done at an early stage (Schrader 1986, Cook & Payne 1997, Dueland et al. 2001), but it is often too expensive for the owners and might not help the dogs that have already developed OA, unless the whole joint is replaced.

Acupuncture is an increasingly popular form of complementary medicine that has been used all over the world for many decades (Mittleman & Gaynor 2000). It usually consists of insertion of fine needles into specific acupuncture points (NIH 1997), which exist all over the body along lines called the "meridians" (Mittleman & Gaynor 2000) . There are hundreds of acupuncture points in the body and different combinations of those points are used to treat various conditions (Gaynor 2000, Scott 2001). Acupuncture practically lacks all side effects and it is a relatively inexpensive treatment and easy to perform (Gaynor 2000). The effect of acupuncture treatment is still controversial and often lies on the personal experience of the treating veterinarian, although there is some evidence of its effectiveness (Martin Jr. & Klide 1987, Jaeger et al. 2006, Suo et al. 2011). Many trials lack adequate control croup and thus the result can be false positive. The placebo effect is also still remarkably influencing the results of acupuncture trials (Ernst 2006).

We conducted a double-blinded placebo-controlled study to find out whether acupuncture treatment has an effect on chronic pain in dogs suffering from CHD and OA. Our study consisted of 19 dogs with diagnosed CHD and OA and who had at least three symptoms referring to hip disorder. Our hypothesis is that dogs' pain and physical difficulties should be reduced and quality of life should be improved in the acupuncture group based on the evaluation of the owners after three treatments given at a week intervals. In the placebo group there should not be such reduction in pain compared to the treatment group. We used valid and reliable Helsinki Chronic Pain Index (HCPI) (Hielm-Björkman et al. 2009), Visual Analog Scales (VAS) (Hielm-Björkman et al. 2011) and lameness evaluation by veterinary students in trot and walk as the main outcome measures. We also thought that the use of rescue medication should be greater in the placebo than in the treatment group. My topic was outlined to subjective assessments since the objective assessment and blood value changes in present study are discussed by other researchers in their theses.

We decided to use dogs that suffer from CHD and OA, because its prevalence is so high and it is easy to find dogs with CHD. It is also quite obvious disease and therefore easy to evaluate, even by the owners. We used owners' evaluation as an outcome measure, because owners are the closest companions of the dogs and are likely capable of detecting changes in their dogs behavior (Hielm-Björkman 2007). Even though owners'

assessment cannot entirely be replaced by veterinary assessment or objective assessment, it has been noticed to be a useful outcome measure (Innes & Barr 1998)

The aim of this study was to see if acupuncture offers any help to chronic pain on dogs who suffer from CHD and OA, since so many veterinarians already swear in the name of it. The disease is quite similar with human OA and can therefore be used as a model for treatment of human OA (Vainio 2012). Therefore, this study hopefully benefits human science as well.

2 LITERATURE REVIEW

2.1 Pain in animals

In the past, great men like Descartes thought that animals lack consciousness and the ability to suffer (Allen et al. 1997). Later, however, the knowledge of animal pain developed and it was described by Molony & Kent (1997) as "an aversive sensory and emotional experience representing an awareness by the animal of damage or threat to the integrity of its tissues; it changes the animal's physiology and behavior to reduce or avoid damage, to reduce the likelihood of recurrence and to promote recovery". It is now recognized that animals do experience pain despite the lack of verbal communication (Paul-Murphy et al. 2004) and almost all human pain syndromes have been documented in animals (Livingston 2010). Pain alleviation is a very significant but challenging area of veterinary medicine today (Rutherford 2002).

Being an entirely subjective experience, the pain of an animal or even a human cannot truly be estimated by another creature (Livingston 2010). Animals do, however, bear the same neuronal pathways, receptors and neurotransmitters used for pain detection as humans so it's fair to assume that animals can experience the same kind of pain that humans do (Livingston 2010). A procedure that is painful to verbal humans is also considered to be painful in nonverbal animals, even if they don't show pain perception in the same way (Hellebrekers 2000).

Pain experiences vary in animals by length. Acute pain is "pain that follows some bodily injury, disappears with healing and tends to be self-limiting" (Gaynor 2002) and it lasts only for a minute (Rutherford 2002). Pain warns the animal of an injury or damage, helps to avoid the stimulus in the future, helps the healing process and the development of a protective demeanor (Bateson 1991). Chronic pain, also described as "non-functional pain" lasts longer than what is the expected time of healing for tissue damage (Molony & Kent 1997) and results from pathological changes in the nervous system (Grubb 2010) and from damage to the underlying mechanisms of the pain process and pain control (Molony & Kent 1997). Chronic pain in animals is caused by similar conditions as in humans, like OA (Livingston 2010).

Pain can also be divided into adaptive and maladaptive pain instead of acute and chronic pain. Adaptive pain is normal and a transient experience that helps to protect from injury and promotes tissue healing. Maladaptive pain, on the other hand, is a persistent or recurrent experience and can result from an abnormal process or damage of the nervous system. Adaptive pain can even become maladaptive if it is not properly treated (Woolf 2004).

Animals have also been reported to suffer from neuropathic pain, which can occur in different conditions, such as amputation, pelvic fractures, limb nerve entrapment, spinal cord injury, inguinal hernia, diabetes, and tumors (Mathews 2008). Neuropathic pain is a form of chronic pain defined as "pain arising as a direct consequence of a lesion or disease affecting the somatosensory system" (Treede et al. 2008, Grubb 2010) and it is an extremely difficult kind of pain to detect and to treat (Mathews 2008, Grubb 2010).

2.1.1 Assessment of canine pain

Pain is an individual experience and the observation and measuring of pain depends on multiple factors (Hellebrekers 2000). Since animals cannot communicate verbally with humans the assessment of animal pain relies largely on observational strategies (Livingston 2010). Signs of animal pain can be generally divided into four categories: loss of normal behavior, expression of abnormal behavior, reaction to touch, and physiologic parameters, such as temperature, pulse, respiratory rate, blood pressure and, pupil dilatation (Hellyer et al. 2007). Physiological changes, which can be the most easily noticed when palpating painful area (Livingston 2010), can indicate pain or stress, but cannot be used as the only sign of pain (Hellyer et al. 2007). Behavioral changes are, however, the most common signs of animal pain (Hellyer et al. 2007), the most often used parameter in assessing pain in animals (Rutherford 2002) and very efficient especially when the evaluation is done by a practiced person. (Livingston 2010). A response to analgesic therapy is also a commonly used method to assess animal pain (Livingston 2010). There is a lot of variance in the pain expressions between ages, species, breeds and even individuals, which makes the assessment of animal pain very difficult (Hellyer et al. 2007, Livingston 2010).

Pain can be assessed subjectively and objectively. For subjective assessment of canine pain different kind of scales have been developed. These can be given to owners to fill in at home, since dogs often behave differently at clinics ant may not show the pain they normally suffer from. The problem of all scales used for assessment of behavior is quantification. Because pain behavior are different in different species it must be also remembered that these scales can only be used to that species for which it has been developed for (Livingston 2010). The most straightforward and easy, but also the most subjective form of these scales is the simple descriptive scale, where the evaluator chooses from four to five points such as "no pain at all", "mild pain", "moderate pain", and "severe pain". The numerical rating scale differs from the simple descriptive scale so that written descriptions have been replaced with numbers, usually 0 meaning no pain and 4 to 5 or 10 the worst pain (Hellyer et al. 2007b). Visual Analogue Scale (VAS) is usually consisted of a 100 mm line with end points no pain at all on the left and the pain couldn't be worse on the right and it has been evaluated to be a valid and reliable tool, but it lacks good face validity when used by untrained evaluators (Hielm-Björkman et al. 2011). Multidimensional pain scales have also been reported to be reliable and valid methods for the assessment of animal pain. There the evaluators assess an animal's behavior and other pain signs with multiple numerical or descriptive rating scales and the sum of these parts relates to the degree of animal's pain (Hielm-Björkman et al. 2009, de Oliveira et al. 2014). None of these scales can, however, be used as a gold standard and they need to be tested universally under various circumstances (Holton et al. 2001). They also don't apparently correlate well with physiological factors associated with pain, such as blood pressure and heart rate (Conzemius et al. 1997).

Objective assessment of orthopedic pain can be done by gait analysis with the force plate, which measures the ground reaction forces of the limbs, which are not visible to an observer (Clayton 2005). Vertical peak forces and vertical impulses are commonly measured ground reaction forces of the Force plate (Gillette & Angle 2008) , vertical peak force being more reliable in hind limb lameness (Fanchon & Grandjean 2007) . Vertical impulse i.e. the sum of the stance phase forces is approximately constant with individual animal since the peak vertical force decreases and the duration of a stance increases with lameness. In lame animals there can be seen asymmetries in left-right vertical and often longitudinal ground reaction forces on the force plate (Clayton 2005).

The accuracy of vertical peak force can be enhanced by combining it with falling or rising slope (Evans et al. 2005, Fanchon & Grandjean 2007, Animal Welfare 2011). Force plates are quite simple machines and available in different sizes and sensitivities (Clayton 2005). It is very usable method for the assessment of lameness in dogs, but unfortunately is not available in all every day practices, so often veterinarians have to rely on subjective assessment. However, subjective assessment might not be as sensitive as objective gait analysis with force plate when discriminating whether the dog is sound or lame (Evans 2005) and it doesn't always correlate well with objective gait analysis (Quinn et al. 2007, Waxman et al. 2008). It varies greatly between different evaluators, it should not be used without caution as an outcome measure and it should not replace objective assessment with force plate (Quinn et al. 2007, Waxman et al. 2008). Severe lameness by subjective assessment correlates more with objective analysis than mild lameness (Quinn et al. 2007). Heart rate, respiratory rate and pupil dilatation are also parameters that can be measured objectively, but Holton et al. (1998a) found out that they cannot be used as clear pain indicator at least in hospitalized dogs. Rutherford (2002) ponders that it is maybe best to combine both subjective and objective assessment to get an overall look of an animal's pain, and to choose the methods depending on the situation and resources.

Animals' responses to acute pain may differ greatly from the responses of chronic pain and thus the same assessment methods cannot be used for both. Acute pain is much easier to notice and thus also to treat, as, like in humans, it is often associated to trauma, some specific body part, acute inflammation, or infectious disease. It is however apparent that to induce a clearly obvious human type of pain behavior, such as vocalization, aggression, rolling or falling down, an extremely painful stimulus is needed. Moderate pain causes less clear changes in an animal's demeanor and they are difficult to notice during a short term observation (Hellebrekers 2000).

The assessment of animal pain varies between the sexes and ages of the observers. Among Finnish and British veterinarians younger and female veterinarians were more likely to estimate the level of pain higher than male veterinarians and those who had graduated earlier and they were also more likely to treat it. (Capner et al. 1999, Raekallio et al. 2003) The availability to a larger amount of analgesic drugs also influenced the evaluation of pain. Cats were often thought to experience less pain than dogs in same the procedures (Raekallio et al. 2003).

2.1.2 Owners' ability of detecting and evaluating pain in their dogs

Dogs are very close companions to humans nowadays and therefore owners are capable of detecting changes in dogs' demeanor, weight and appetite. The best evaluators of animal pain have been suggested to be the people who know the species, breed and individual the best (i.e. animal owners and veterinarians) (Molony & Kent 1997). Owners have the closest relationship to their dogs so they are probably the best evaluators of their dogs' pain, especially when trained (Hielm-Björkman 2007). According to (Innes & Barr 1998) the dog owners' assessment also appears to be a useful outcome measure at least when considering cranial cruciate ligament deficiency post-surgery healing, but it cannot be replaced by a veterinary surgeons assessment. Though, if there is no objective analysis available, owner assessment is probably the best assessment tool (Jaeger et al. 2006). Most of the dog owners are able to detect changes in their pet's behavior and thus they can be very helpful in demonstrating/showing the pain of an animal. For the veterinarian the task is much harder because dogs usually behave differently in a clinic situation, show the pain signs less clearly and the veterinarian is not familiar with the dog's normal behavior (Hellebrekers 2000). Still, untrained owners do not recognize certain changes in locomotion and behavior as a sign of chronic pain (Hielm-Björkman et al. 2011) and the owners' ability to assess their animals' pain is not always trusted by veterinarians (Raekallio et al. 2003).

In a preliminary study done by Wiseman et al. (2001), owners reported that mobility, activity, demeanor, and sociability were the types of behavior that changed the most often with dogs suffering from chronic pain. Behaviors that increased were negative, like aggression, anxiety, restlessness, dependence, and behaviors that decreased were positive like activity, mobility, curiosity, sociability, and playfulness. The study data suggests that owners can be used to assess behavioral changes with dogs suffering from chronic pain and those changes can be noticed by owners even better after treatment. Rapidly developing changes in behavior, like the ability to lie down, to stand up, to jump, or to descent stairs, may be better noticed even by untrained owners compared to changes that develop more slowly, like vocalization, panting and gait. Absence of vocalization might also be wrongly understood as absence of chronic pain, because vocalization is a commonly known mark of pain in humans (Hielm-Björkman et al. 2003).

Stress is quite closely related to pain and its recognition by owners is of importance for dogs' welfare. Mariti et al. (2012) conducted a study to evaluate how dog owners understand stress behavior in their dogs. A little over half of the 1190 respondent Italian dog owners could correctly determine the concept of stress, women and people with higher educational level being more likely to answer correctly. Majority of the responding owners believed that their dogs do go through stressful situations, which means that owners think that they are capable of evaluating if their dogs are stressed. The most often identified stress signs by owners were whining and trembling, which are quite easy to detect because they are among humans seen as signs of fear and anxiety, which often foregoes stress. Other sings often reported were also very obvious like barking, aggression and panting. More subtle signs, like turning head away, looking elsewhere, nose licking, and yawning were not well recognized which is why it is important to educate dog owners to evaluating these early stress sings to avoid canine welfare problems. People who could detect milder stress sings were more likely to report that their dogs suffered higher levels of stress and the opposite. This means that a people who have more knowledge about canine behavior can understand dogs' emotional state better. Stress behavior sings were also identified better if stress was correctly defined (Mariti et al. 2012). Since stress responses are quite similar to pain behavioral responses (Livingston 2010) it's of an importance to educate dog owners to assess these responses in their dogs.

2.2 Acupuncture in animals

Acupuncture is an ancient, probably Asian method used to produce analgesia or other therapeutic effects and it is done by stimulating specific anatomic points in the body (Mittleman & Gaynor 2000) . It is probably the most popular form of so called complementary medicine and its interest has recently grown in the field of veterinary medicine, mainly driven by public demand. Although there is limited evidence of the efficacy of acupuncture, many pet owners are searching for alternative treatment options for their pets. Recently the number of veterinarians that treat animals by acupuncture has risen significantly and the interest for attending acupuncture courses is growing (Scott 2001). The research in western countries concerning animal acupuncture began over five decades ago and the International Veterinary Acupuncture Society was founded in the 1974 (Klide 1977, IVAS 2015b). The use of acupuncture in treating various painful conditions, such as postoperative dental pain, has been stated to have

good evidence according to National Institutes of Health (1997), so it is also likely to be the best scientifically supported form of complementary and alternative medicine.

Veterinary acupuncture has developed parallel of human acupuncture (Haltrecht 1999) and the majority of the locations and names of the acupuncture points in animals have been mimicked from human anatomy, however they are not necessarily in the same anatomical location even among same species (Klide 1977, Schoen 1994, Hwang 1992). The most famous form of acupuncture is the insertion of fine metallic needles in specific locations, acupuncture points, through the skin (NIH 1997) and the most used targets are chronic pain and inflammation (Xie & Ortiz-Umpierre 2006). Animals usually accept the needles very well and they become very relaxed during the treatment which lasts 10-60 minutes depending on the treatment method and target (Scott 2001). Acupuncture is easy to perform and practically lacks any side effects (Gaynor 2000). There are many guidelines on which acupuncture point combinations to use in which conditions but the points are however always chosen individually and depending on the situation (Gaynor 2000, Pascoe 2002). Many times acupuncture is performed on the affected area, but the opposite or contralateral side is also used (Gaynor 2000). Though there are hundreds of acupuncture points on the body, only a relatively small number of points are used in practice (Whittaker 2004). As acupuncture is defined as a surgical procedure, in most western countries it can only be given by a licensed veterinarian certified in veterinary acupuncture.

Acupuncture can be used to treat several different ailments in dogs, pain management, athletic and geriatric medicine being the three most common (Xie & Ortiz-Umpierre 2006). The International Veterinary Acupuncture Society (2015a) also lists musculoskeletal, respiratory, skin, gastrointestinal and selected reproductive problems as general conditions which can be treated with acupuncture in small animals.

2.2.1 The Function of acupuncture

The function of acupuncture can be viewed from two angles. The traditional Chinese Veterinary Medicine believes that energy of life, called *qi*, runs through an animal's body via routes called meridians. The acupuncture points are located on these meridians and the treatment can be given to the patient through these points with needles (Gaynor

2000, Cantwell 2010). According to this perception, pain can result of obstruction and malnourishment of the channels and acupuncture stimulation can help to return the circulation and thus normalize the body balance (Gaynor 2000). From a physiological and anatomical point of view the acupuncture points exists at points where the nerves bifurcate or penetrate tissue planes, like muscle motor points, tendons, or sagittal planes, and they can be recognized by an ohm meter as they have a high electrical skin conductance and a low electrical resistance (Gunn et al. 1976). The points can also usually be palpated as depressions on the skin (Cantwell 2010). Histologically there are usually free nerve endings, arterioles, veins, and lymphatic veins surrounded by loose connective tissue together with a mast cell retention at the acupuncture points (Egerbacher 1994, Schoen 1994). There are at least 350 of these acupuncture points in the body (Cantwell 2010) and most of the acupuncture points are located on all together 14 meridians (Xie & Ortiz-Umpierre 2006) .

Acupuncture affects and acts via both peripheral and central nervous system and it also affects the immune system (Mittleman & Gaynor 2000) . When the acupuncture points are stimulated, small tissue damage activates an inflammation cascade and a release of histamine and endogenous hormones, such as endorphin and serotonin (He 1987, Petti 1998). Erythema and heat develop around the point, which can be due to the release of histamine, and vasodilation or the irritation of the tissue (Mittleman & Gaynor 2000). Because opioids play a role in the immune system, acupuncture leads to an increase in the number of white blood cells in the blood, an increase of monocyte phagocytosis and an increase in activated T-cell lymphocytes (Petti 1998) and thus it can also be a beneficial treatment for immunodeficiency patients (Mittleman & Gaynor 2000). The stimulus is conducted to the central nervous system by large myelinated nerve fibers, which increases the release of β-endorphins and serotonin even more. These substances together with other endogenous opioid peptides and neurotransmitters block the ascending pain impulse (Janssens et al. 1988). It is reported that acupuncture analgesia can be inhibited by the opioid antagonist naloxone which indicates that the neurohumoral pain inhibitory system, including β-endorphin and other endogenous opioids, is a significant part of the analgesic effect of acupuncture (Pomeranz & Chiu 1976, Mayer et al. 1977) . Acupuncture also acts via the “gate control, theory” (Melzack & Wall 1965) . Acupuncture stimulates the acute pain carrying A-delta fibers which cause interneurons to block the chronic pain carrying C-fibers. Since these pain signals

cannot be noticed by the brain simultaneously, the acute pain caused by the needle or other acupuncture stimulus "wins" and chronic pain is no longer perceived.

2.2.2 Acupuncture modes

Dry needle acupuncture is the most commonly used form of acupuncture (NIH 1997). It includes insertion of fine, flexible, usually 28-34G (0,25-0,38 mm) thick and 1,25-2,5 cm long (Schoen 1994) sterile needles into acupuncture points and left there for a certain period of time. The time of the treatment depends on the need and the disease of an animal, usually being 10-30 minutes, but even up to 60 minutes. The effect can be enhanced by twisting or moving the needles after placement. The depth and the angle of the needle depend on the size, age and health of the patient and the point used. (Cantwell 2010, Parrah et al. 2012) It is inserted into an acupoint by a quick rotating movement and it does not usually cause any pain to the patient. An experienced acupuncturist can often feel when the needles reach the acupoint and the patient experiences a "*deqi*" (Schoen 1994).

Electroacupuncture is also commonly used in animals. There an electrical stimulus is applied on the skin or to the needles in the acupuncture points, which can produce a prolonged or more effective analgesic effect (Xie & Ortiz-Umpierre 2006). The electricity ca be led to the acupuncture points through needles, which acts as electrodes, and it is also called as "percutaneous electrical nerve stimulation or PENS" (Gaynor 2002). Generally, the millivoltage is set so that the animal barely notices it and electric frequencies are somewhere between 1-200 Hz (Cantwell 2010). Lower frequencies (2-8 Hz) work through activation of opioid and NMDA receptors and are apparently more effective in treating neuropathic pain than higher frequencies (100Hz), which, on the other hand, activate serotonergic and GABAergic systems (Xing et al. 2007).

Aqua-acupuncture is a form of acupuncture where, to prolong the effect, fluid is injected into the acupuncture points. Fluids can contain various substances: for example saline (Martin Jr. & Klide 1987) , vitamin B12 (Chang et al. 2012), beevenom (Kim TaeHwa et al. 2006, Yoon et al. 2009) and autologous cells (Marx et al. 2014). This is a suitable mode of acupuncture for animals who do not tolerate needles to be held in place for long periods of time (Cantwell 2010). Pharmacoacupunture is a form of aqua-

acupuncture where small doses of drugs, for instance acepromazine, are injected into acupuncture points to equipotent their effect (Luna et al. 2008, Jæger et al. 2012).

Laser acupuncture is stimulation of acupuncture points by using non-thermal, low intensity laser stimulus (Whittaker 2004). Energy between 5-30mW and wavelength between 630-960 nm is commonly used in veterinary medicine. The benefits of laser acupuncture are that it can be used on thin skin areas and shallow acupuncture points (Cantwell 2010). It has clinically been used as a form of acupuncture since the 1970s (Whittaker 2004).

Gold bead implantation is a form of long term acupuncture where small pieces of gold (usually 24-karat) or other materials, such as surgical suture, wire or skin staples, are introduced into acupuncture points and left in situ. The procedure is done by using large (for example 14 G) needles, under general anesthesia and after surgical preparation of the area (Schoen 1994, Hielm-Björkman 2001, Jæger et al. 2012). Although gold bead implantation is quite easy, safe and quick to perform, it may have some adverse effects. If the needle is accidentally introduced into the joint, synovial or blood leakage may occur. It is more likely to appear if the HD is severe rather than mild or moderate. Pain and discomfort may also appear up to four weeks after gold bead implantation, but long-term complication, such as bead migration or infection, are rare (Jæger et al. 2012). Indications mentioned for gold bead implantation include OC, OCD, DJD, ventral spondylosis, and seizures (Durkes 1992).

Acupressure is a simple and probably the oldest form of acupuncture performed by digital pressing of the acupoint for 5-10 minutes (Xie & Ortiz-Umpierre 2006, Schoen 1994). However, it is not very commonly used in veterinary medicine (Schoen 1994). The techniques include pressure, pinching, rubbing and rubbing between palm, thrusting, grabbing, rolling, taping, and blunt needle pushing (Parrah et al. 2012).

Warming of the acupuncture points by using burned herbs is called moxibustion. There dried leaves of *Artemisia argyi* or *Artemisia vulgaris* are crushed- , rolled into cigar like “moxa” sitcksand burned over the acupoint or over the needle inserted into acupoint (Xie & Ortiz-Umpierre 2006, Parrah et al. 2012).

In pneumoacupuncture stimulation of the acupoint is conducted via pressure by injecting fresh air into acupoint. Pneumoaupuncture is used for example for the treatment of hip or shoulder muscle atrophy (Xie & Ortiz-Umpierre 2006).

Acupuncture can be regarded as a very safe method, when done by an experienced and trained person, and adverse effects are very rare or even absent (Rogers 1981). Still, some precautions need to be considered when performing acupuncture. Needles shouldn't be placed in areas of inflammation or infection, near sites of acute trauma or fractures or through or near tumors (Xie & Ortiz-Umpierre 2006). Acupuncture enhances blood flow and can thus promote cancer enlargement (Gaynor 2000). Pregnant animals shouldn't be treated around the abdomen or in some specific points since it may cause premature parturition (Xie & Ortiz-Umpierre 2006). There is also a risk that acupuncture can cause bleeding, when used for animals with clotting abnormalities (Gaynor 2002). There is also a risk of penetrating the joint capsule unless being careful, especially in dogs suffering from severe HD and with greater joint effusion (Jæger et al. 2012). It may lead to considerable pain if the gold beads are introduced into the joint (Durkes 1992) and they require immediate surgical removal. Excessive movement of the patient should be prevented when performing acupuncture (Gaynor 2002) and hard training should not be performed for couple of hours after acupuncture treatment (Xie & Ortiz-Umpierre 2006). Only flawless needles should be used to avoid unnecessary irritation or trauma (Schoen 1994). When treating geriatric or other weak patients fewer acupoints should be used and other cautions also taken into consideration (Xie & Ortiz-Umpierre 2006). Electroacupuncture should not be used on animals suffering from seizures, epilepsy or around thorax in sedated animals, and it is also contraindicated in case of shock, pregnancy, fever and cardiac arrhythmias. Serious adverse effects, including organ or coelom puncture, usually result from inappropriate use or misuse of acupuncture (Rogers 1981), and thus is it is crucial that acupuncturists know the anatomy of the treated patient and proper acupuncture techniques. Minor adverse effects reported after acupuncture treatment range from nausea to mild bruising and skin irritation (MacPherson 2001) but these can be considered as "normal" acupuncture affects.

2.2.3 Acupuncture for the treatment of canine hip dysplasia

Many different forms of acupuncture have been studied in order to find pain relief method for canine hip dysplasia and many case studies support the efficacy of acupuncture in treating pain associated with CHD (Durkes 1992, Kothbauer 1997, Scognamillo-Szabó et al. 2010, Chang et al. 2012) but there is still some lack of statistically significant data on this subject.

There are variable results of gold bead implantation on canine hip dysplasia (Hielm-Björkman et al. 2001, Bolliger et al. 2002, Jaeger et al. 2006) and the reason is often a remarkable placebo effect of the treated placebo group. In the placebo treatment groups needles were usually introduced into non-acupuncture points and without gold beads. (Hielm-Björkman et al. 2001, Bolliger et al. 2002) couldn't prove the efficacy of gold bead implantation on CHD in their double-blind clinical trials, since there was not enough difference between the treatment and the placebo group, even though the locomotion improved significantly in both groups in the first mentioned trial. Instead, (Jaeger et al. 2006) could later show a significantly greater difference in reduction of pain signs and increase in mobility compared to placebo group, even though placebo treatment also had a significant effect.

Injection of autologous cells of the vascular stromal fractions and allogeneic, cultured adipose-derived stem cells have also showed to have clinical effect on pain caused by hip dysplasia in dogs and it can be considered as a safe method (Marx et al. 2014), but the trial lacks control groups, so further studies need to be conducted to prove the significant efficacy of this treatment method.

Acupoint combinations used to treat CHD have in most cases been GB 29, BL 54 and GB 30 sometimes combined with 1-3 trigger points or points with higher electrical conductivity, which also have been located around the hip joint (Hielm-Björkman et al. 2001, Jæger et al. 2012). GV-1 (Chang-qiang) and Bai-hui have also been used (Chang et al. 2012).

3 MATERIALS AND METHODS

3.1 The research material

19 dogs with CHD and OA were included into the trial. The dogs were collected by advertising in the biggest local newspaper, in dog parks' and pet stores' advertising walls and on breed organizations' internet forums. The dogs were chosen to the study by a questionnaire that the dog owners had completed on the internet.

The inclusion criteria were: radiographically diagnosed severe uni- or bilateral CHD categorized as D or E (scale from A to E) and OA, no problems with other parts of the body (for example elbows and back), at least two typical "hip dysplasia" symptoms (such as lameness in hind legs, difficulty in jumping, difficulty in lying down or getting up or soreness when hind legs were stretched) and a minimum duration of the symptoms of at least three months. The dogs had to have enough chronic pain according to the HCPI (index over 11), which was calculated from the internet questionnaire. Dogs were not included if they had had prior acupuncture, gold bead implant treatment, surgery or Carthrophen®-injections within the last three months or if they had neurological deficits, articular infection or systemic or infectious disease

The dogs also had to weight over 20 kg's because of the gait analysis that was done during the study and due to a larger amount of blood that was taken for blood analysis from the patients. Dogs that weighted over 20 kilograms but had legs too short (for example Staffordshire bull terriers) could not be included because they were not capable of doing of the gait analysis.

The goal was to get 20 patients into the research. The inclusion criteria had to be eased a bit because there were not enough available patients that filled all the criteria. For that reason we also included patients with elbow and back problems, a dog weighting a bit under 20 kilograms but who could use the force plate and a dog who had had surgery (laparotomy) but did not have any signs referring to that operation anymore.

The owners of the dogs signed a written consent for the participation of their dogs in to the trial and the study was approved by the Viikki Ethical Board of the University of Helsinki.

3.2 The Study

This study was designed as a prospective randomized double blinded case-controlled study. The overall sample size was calculated to be about 70 dogs out of which 20 dogs would be treated in Finland, because this trial is part of a larger multi centered study which is also done in Sweden and Brazil. The work was done at the facilities of the University of Helsinki, Faculty of Veterinary Medicine, Department of Equine and Small Animal Medicine.

The dogs were divided by random sampling into two groups: the treatment and the negative control group i.e. the placebo group. The stratifying factors used in the randomization were pain killer usage (less than once a week = low pain killer usage, weekly or more often = high pain killer usage) and HCPI level at inclusion (≤ 16 = low HCPI and ≥ 17 = high HCPI). These values were taken from the first questionnaire the dogs' owners filled in during the study.

The treatment group received dry needle acupuncture treatment all together three times about one hour per treatment. The placebo group got placebo treatment which meant that they only stayed in a room with the treating veterinarian for an hour and no procedures were done to the dogs during this time. As it has been shown that insertion of needles also in non-acupuncture points has almost the same kind of effect as acupuncture (Cho et al. 2002), no treatment at all was given to the dogs in the control group. This could be done as none of the evaluators (the owners or the researchers) knew which treatment the dogs received and therefore the study was double blinded. Only the veterinarians who gave the acupuncture treatment knew to which group the dog belonged.

This particular trial consisted of three different parts. My goal was to find out how the dogs' chronic pain changes during the research according to the owners answers of the pain questionnaires. We also tried to find out how the dogs' lameness developed according to gait analysis from the force plate and from the gait force carpet. The last goal was to find out what happens in the dogs blood values after acupuncture treatments. Gait analysis and blood samples will be discussed much more in detail in the other two researchers', Teija Pylkäs's and Grim Wickholm's, licentiate theses.

3.3 The visits

The dogs visited the hospital five times, approximately one week (4-8 days) between each visit. The time between the baseline visit and the first treatment visit was allowed to be a bit shorter. Before the first visit the dogs had to be off NSAIDs for at least 2 days.

At the first treatment visit the dog owners also got some emergency pain medication (Metacam®) to take home and to give to their dogs if they considered the dogs to be in pain. The factual use of the pain killers was used as an outcome measure and was therefore expected to be greater in the placebo group.

The dog owners had to pay 60 euros at the first study visit which covered for the radiographs of the hips, blood samples and gait analysis that were done whether the dog was selected to the actual trial or not. Also the target of this amount was to ensure the commitment of the dog owners to the study, and this target was reached since everyone involved in the actual study completed the study.

3.3.1 The clinical work done at visits

All the clinical work except for the treatment was performed by three 4th year veterinary students and one licensed veterinarian who were all blinded to the treatment. The clinical work done at each visit is shown in Table 1. The order of the procedures is the same as presented in the table. It was debatable whether the blood samples should have been taken before the gait analysis because some blood values could increase during the running due to sympathetic activation. However, it was decided to do the procedures in this order so that the blood sampling with needle would not affect the dog's lameness. The owners completed the questionnaire during each trial visit but otherwise they did not help with the procedures unless needed (a couple of times help was needed for the gait force analysis because some dogs didn't want to run with the researchers). The only exception was the lameness evaluation, which was done and videotaped outdoors with the owners immediately when the dog and the owner arrived to the hospital.

TABLE 1. The clinical work done at each visit.

TRIAL WEEK	CLINICAL WORK
W_{-1} (Inclusion)	• *Lameness evaluation* • *Clinical examination* • *Gait analysis* • *Cannulation of the patient* • *Blood samples - > basic blood values* • *X-rays of the hips (if needed) in light anesthesia* • *Filling in the questionnaire by the owners*
W_0 (Baseline visit, 1st treatment visit)	• *Lameness evaluation* • *Clinical examination* • *Gait analysis* • *Blood samples* • *Acupuncture/placebo treatment for 45 min* • *Filling in the questionnaire by the owners*
W_1 (2nd treatment visit)	• *Lameness evaluation* • *Clinical examination* • *Gait analysis* • *Acupuncture/placebo treatment for 45 min* • *Filling in the questionnaire by the owners*
W_2 (3rd treatment visit)	• *Lameness evaluation* • *Clinical examination* • *Cannulation of the patient* • *Resting for 15 to 30 minutes* • *Blood samples* • *Acupuncture/placebo treatment for 45 min* • *Blood samples* • *Filling in the questionnaire by the owners*
W_3 (Follow-up visit)	• *Lameness evaluation* • *Clinical examination* • *Gait analysis* • *Blood samples* • *Filling in the questionnaire by the owners*

3.3.1.1 Lameness evaluation

For this procedure the dogs were run in a triangle on the asphalted yard of the animal hospital and the dogs' walk and trot were evaluated and scored from 0 to 4 (0 meaning no lameness and 4 meaning the worst possible lameness i.e. the dog refuses to move at all or doesn't bear weight at all on some leg). The runs were filmed for a later inspection if it would be necessary.

3.3.1.2 Clinical examination

This examination consisted of measuring heart rate and a restricted orthopedic and neurologic examination. The dogs' back, hind legs, fabellas and toes were palpated and stretched to evaluate possible pain. With-drawal reflex and proprioception were checked in case of neurological problems with the legs. Hips were also stretched back to see how up they rose and if the dogs were tender from the hips. The dogs were also weighted at every visit and given a body condition score (1= severe underweight, 2=mild underweight, 3=normal weight, 4= mild overweight and 5=severe overweight) at the first visit.

3.3.1.3 Gait analysis

This objective analysis was done by a Kistler force Plate and by using a Gait Four carpet. The dogs were trotted over the plate and carpet as many times as needed to get at least 5 good measurement from each leg from the plate and carpet. The velocity and acceleration of the dog had to be similar at each run, because the vertical force of the legs changes with the speed variation. Gait analysis wasn't done at W_2 to minimize the stress dogs suffered from and because the dogs were cannulated. This section will be discussed in more detail in Teija Pylkäs's licentiate thesis.

3.3.1.4 Blood samples

At the first visit only one 6ml serum tube of venous blood was taken from the dogs (vena cephalica) to determine basic serum values in case of some basic organ dysfunctions. At the following visit all together 6 tubes of blood were collected: two 6ml serum tubes, one 9 ml LH tube, one 9 ml EDTA tube, one 3 or 1 ml EDTA tube and one 2 ml LH tube. The tubes were centrifuged, 9 ml tubes a in cold centrifuge and all others normally. Hematology examinations were done from the small EDTA tubes. All the tubes were frozen in -80°C for later blood value determination. At W_1 no blood samples were taken from the patients so that they wouldn't be so stressed when they went to the room for their first treatment. At W_2 the dogs were cannulated and let to rest for fifteen to thirty minutes. Blood samples were the taken from the cannula just before

and after the treatment to see if there is any change in the blood values immediately after the treatment. All the blood samples were taken primarily from the vena cephalica, but a few times also v. saphena was used. This section will be discussed more specifically in Grim Wickholm's licentiate thesis.

3.3.1.5 Radiographs

Many of the dogs had already official radiographs and hip score reports from the Finnish kennel club, but if they didn't have those or other previous X-rays we radiographed the hips at the first visit (W_{-1}). The dogs were cannulated, sedated intramuscularly with butorfanol 0,1 mg/kg (Butordol® 10 mg/ml) and dexdomitor 0,01mg/kg (Domitor® 1 mg/ml) before the X-ray and woken up with an intramuscular injection of atipamezol 0,025-0,05 mg/kg (Antisedan® 5 mg/ml 1mg/kg) after the X-ray. The radiograph was taken from the ventrodorsal aspect where the dog's legs were extended straight backwards as they went or in a "frog-position" if the hips were too painful and stiff and they could not be stretched back. Radiographs from every dog were however collected, and the radiographic changes were re-evaluated by a veterinary radiologist at the animal hospital.

3.4 The questionnaire

The owners completed a questionnaire all together six times, first on the internet and then at every study visit. The questionnaire on the internet included questions whereby the dogs were selected into the trial and invited to the first inclusion visit. The dog owners were asked about the dog's previous health history, for example if it had official radiographs and statements of the hips, if it had some problems with other parts of the body (elbows, back, knees etc.), if it had some other illnesses, what kind of symptoms does the dog suffered from, how long the symptoms had lasted and had the dog's hip dysplasia or other problems been treated before and by what method and/or medication. The dog owners' contact information and the dog's name, weight, gender, breed, and age was also asked. This questionnaire also included a HCPI questionnaire, two Visual Analogue Scale (VAS) questionnaires, questions about the dog's general welfare and medication during the last month. The same questionnaire was used to select patients

for a genetic hip dysplasia project so the owners were asked whether they were interested in participating in the acupuncture or gene research, or both.

The questionnaires the owners completed during the actual study were similar to the one they completed for inclusion. It included a section on basic information about the dog, a HCPI, two VASs and questions about dog's welfare and medication.

The extended HCPI questionnaire used in this study included 23 questions about the dog's mood, behavior and locomotion each with a descriptive scale from 0-4. These questions were used for the measurement of the dog's chronic pain. Eleven (11) out of these questions were the actual HCPI questions and based on those questions the dogs got points from 0 to 44, zero meaning no chronic pain. The total index could then be something between 0 and 44. Our inclusion limit regarding the HCPI was set to 12, since we wanted dogs with enough chronic pain into the study so that a change in the pain could be noticed easier. The HCPI has proved to be a valid and reliable tool for assessment of chronic pain in dogs suffering from OA and it can be used as an outcome measure in clinical trials where owners are used as evaluators like in this study (Hielm-Björkman 2007).

The two Visual Analog Scales concerned dogs' quality of life (QOL) and locomotion difficulties. The owners marked their answer on a 10 cm long line and the answers were scored from 0 to 10. Zero meant no locomotional difficulties and the best possible quality of life and 10 meant the worst possible situation. The welfare questions clarified if the dogs have had diarrhea, nausea, skin disorders and how the dog's appetite had been. These questions are in the questionnaire to tell if the treatment or if the use of analgesics caused any adverse reactions.

Owners also had to mark how they had given pain medication to the dog during the last week, and if they had given any other products, like oils, or pain treatments to the dog. However these products were recommended not to be given to the dogs during the trial unless truly needed.

The questionnaire at W_1 also included 28 comparative questions concerning the dog's locomotion, pain, overall well-being and skin and coat condition. The aim was to compare the dogs' wellbeing before and after the treatments. These questions were

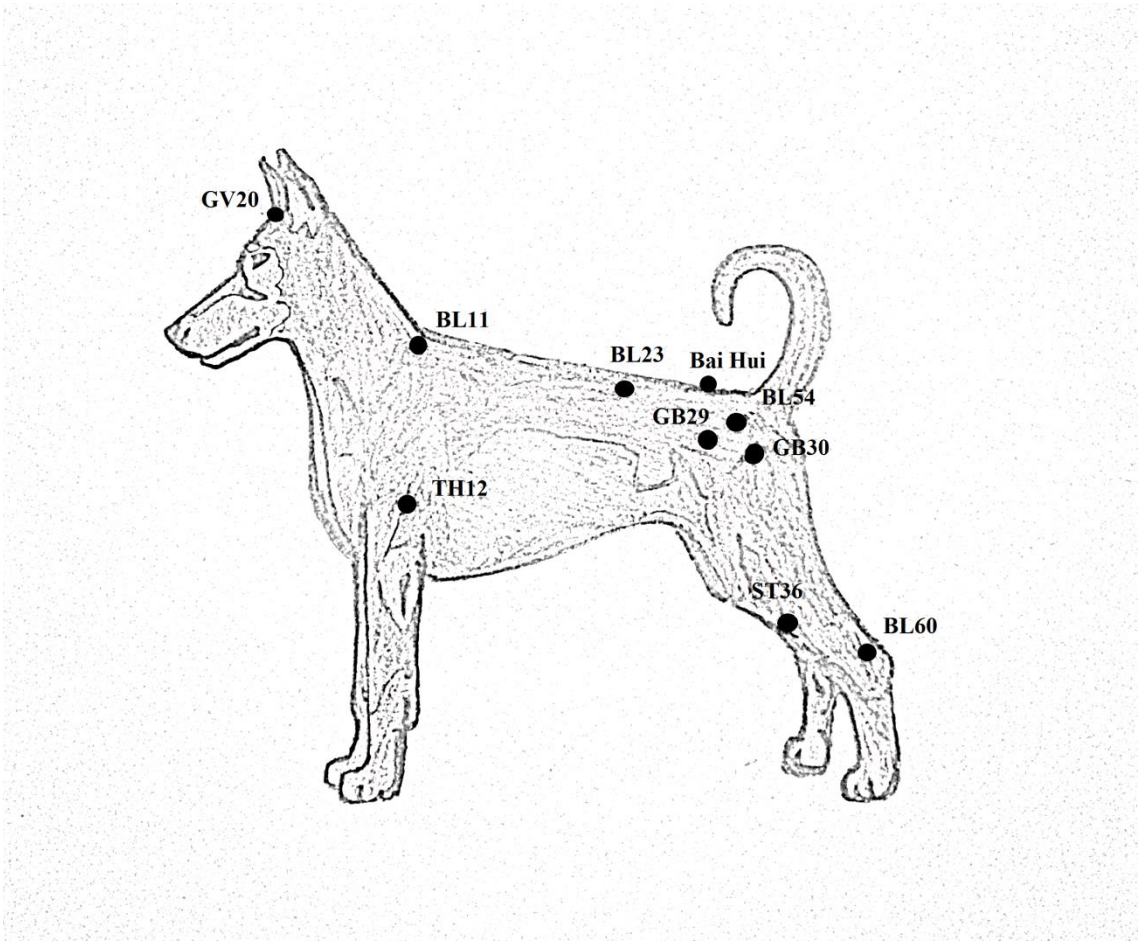
scored from 2 to -2, 2 meaning a lot better, 1 a little better, 0 no change, -1 a little worse and -2 a lot worse, and the score of every question was summed.

The last questionnaire at W_3 (Appendix 1) included questions about the survey: were the owners happy with the treatment result and had it met their expectations, to which group they thought their dog belonged to and would they participate in a similar trial again or recommend a similar treatment to someone else. They were also asked if they think they need the products (nutrition oils, medications etc.) they had used before the survey in the future and have they done something differently with the dog during the study which could have influenced the dog's pain, for example more exercise, weight control, moving to another apartment etc.

The owners completed the questionnaire at every visit always by the same person or people and considering the same situation. For example if the questionnaire was completed the first time after the dog had had a lot of exercise it had to be completed thinking about the dogs condition after exercise also in the future. The person who completed the questionnaire had to live in the same household as the dogs so that she or he would be familiar with the dog and could notice the possible changes in the dog's behavior during the study. No guidance was given to the owners regarding the interpretation of the questions and the dogs' owners were not trained as evaluators. The only instructions given were to fill in all parts of the questionnaire and to put only one answer per question. All the questionnaires were in Finnish language.

3.5 The treatment

The treatment during the trial was given alternately by two veterinarians certified and experienced in veterinary acupuncture. The treatment consisted of a dry needle acupuncture treatment in the treatment group. Once the needles had been placed in in the acupuncture points they were left *in situ* for about 45 minutes. The dogs in the placebo group only laid in the treatment room for an hour. The acupuncture points used are presented in picture 1.



Picture 1. The acupuncture points used in the study.

3.6 The statistical methods

The overall sample size was calculated using a two-tailed test, the statistical power of 80 and α-error of 5%. Non-parametric test were used in the present study to due to the small sample size. Mann-Whitney U test was used between the groups to detect possible statistical differences at every study week. Wilcoxon Signed Rank test was used within the groups to calculate whether there is a significant difference in the change of the variable between the beginning (W_0) the end (W_3) of the study. Mann Whitney U test was also used to detect possible baseline bias. Post randomization bias was avoided by leaving none of the results out. The test of normality was calculated by Shapiro-Wilk test. The statistical significance was set at $P<0.05$ with all tests.

4 RESULTS

TABLE 2. Demographics of the dogs

Num.	Breed	Age (years)	Sex (F/M)	Weight (kg)	BCS	Hips	Group (A/P)
1	Labrador Retriever	13	(M)	31,9	3	E/D + OA!	A
2	Lagotto Romagnolo	8	M	18,8	3,5	E/D + OA!	P
3	Dobermann Pinscher	4,5	F	34,6	3	D/D + OA	A
4	Collie (long haired)	12	(F)	21,0	3	E/E + OA!	P
5	Labrador retriever	6	F	28,4	3,5	D/D	P
6	German Shepherd	8	F	31,3	2	D/D	A
7	Labrador Retriever	9	F	37,3	4,5	D/D	P
8	Samoyed	4	F	25,1	3	E/E + OA!	A
9	Labrador Retriever-mix	7	F	26,8	3	A/E + OA!	A
10	Labrador Retriever	12	(M)	36,9	3	A/D + OA!	P
11	Labrador Retriever	13	(F)	33,6	4	E/E + OA!	A
12	German Shepherd	3	M	35,7	3	D/D	A
13	Mixed breed	2,5	(M)	55,4	4	E/E + OA!	P
14	Samoyed	8,5	F	22,5	3	E/D	A
15	Rottweiler	5	F	36,4	3	E/E + OA!	A
16	German Shepherd	4,5	M	40,3	3	E/E + OA!	A
17	German Shepherd	8	F	34,0	4	D/D	P
18	Flat-Coated Retriever	8	F	28,7	3	D/D	P
19	Labrador Retriever	2	F	30,9	3,5	E/E + OA	P

BCS = Body Condition Score (1-5), Hip dysplasia scale: A (normal) to E (severe disease), OA= Osteoarthritis, OA! = Severe osteoarthritis

All of the nineteen dogs completed the study. Twenty two dogs were invited to the inclusion visit (W_{-1}) where it was ensured that the dogs were eligible for the research. However, three dogs had to be excluded before the beginning of the actual study because they either didn't have enough changes in the hips or they had some serious primary infectious disease. The demographics of the dogs are shown in table 2.

The age distribution of the dogs was between 2 and 13 years, mean age being 7.3 years. The main breeds in the study were Labrador retrievers (n=6); German shepherds (n=4) and Samoyeds (n=2), but there were also dogs form other breeds and one mixed breed dog. The mean bodyweight at the baseline visit (W_0) was 32,13 kg (18,8-55,4 kg). There was no significant change in the bodyweight between the two groups at any points of the study (P=0.078-1.0). The main HCPI at inclusion visit (W_{-1}) was 16.10 in the acupuncture group and 18.67 in the placebo group and they both decreased at W_0 to 15.9 and 17.44 respectively. At both weeks there was no significant difference between the two groups. The results of lameness evaluation in trot and walk were normally distributed (P<0.05) whereas other were not in whole (P>0.05). There were on average 6 days between the study visits. Regarding to the main outcome variables, there was no baseline bias between the two groups (P<0.05).

There was no significant difference between the acupuncture and the placebo group regarding the change of the HCPI (P=0.72), locomotion VAS (P=0.84), QOL VAS (P=0.91) or lameness in trot (P=0.45) and walk (P=0.32) There was also no difference in these variables at any point during the study. However, there were several significant differences in the acupuncture group when baseline (W_0) was compared to the last visit (W_3) and only one variable significantly different in the placebo group. In the acupuncture group HCPI (P=0.012), QOL VAS (P=0.012) and lameness in trot (P=0.025) changed significantly and lameness in walk was borderline (P=0.063). There was no significant difference in the acupuncture group in locomotion VAS (P=0.155). In the placebo group, instead, there was significant difference between W_0 and W_3 in locomotion VAS (P= 0.043) but not in other variables (HCPI, QOL VAS or lameness in trot and walk). There was no difference between the groups or within the groups regarding the use of rescue medication when baseline was compared to W_3, but it was significantly different in both groups when comparing W_{-1} to W_3 (acupuncture P= 0.04, placebo P=0.008). However, none of the dogs in the placebo group received rescue medication at baseline ($W_{0)}$ or W_3 so the difference couldn't be calculated with certainty. The mean values and the range of the main variables at every study week are shown in tables 3-7 (group 1= acupuncture, 2= placebo).

Table 3. The range and mean values of HCPI at every week

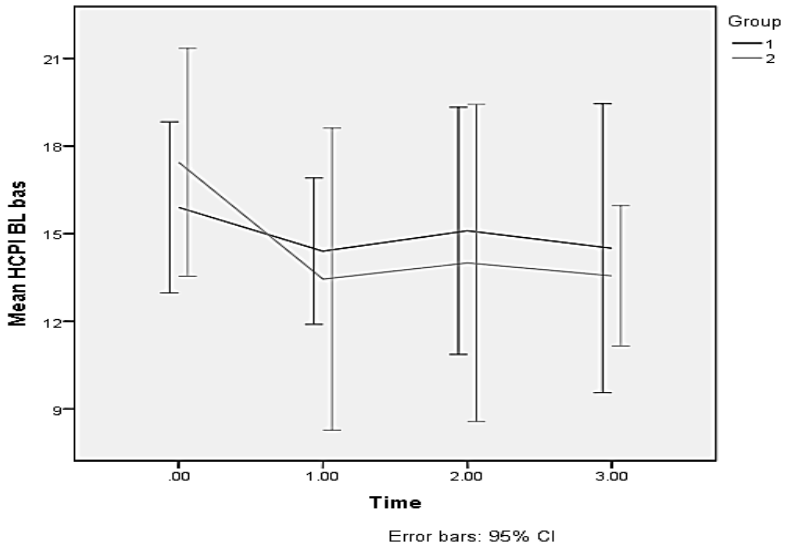


Table 4. The range and mean values of locomotion VAS at every week

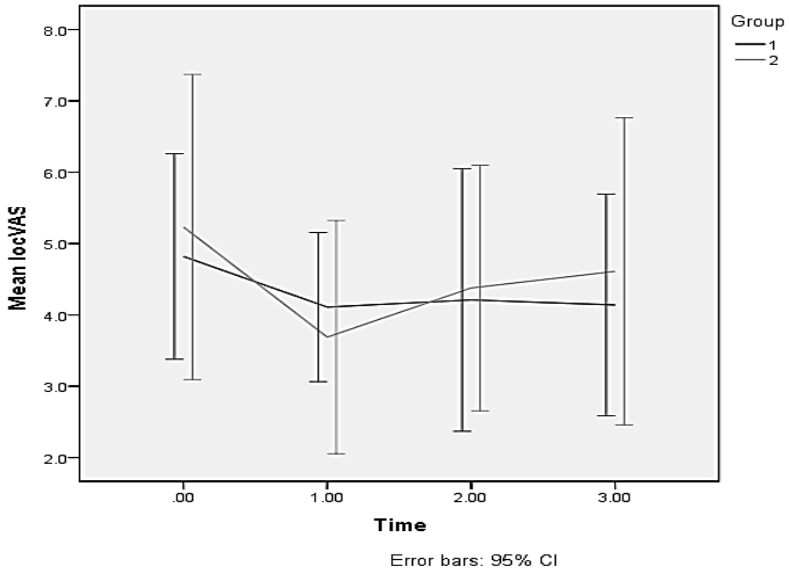


Table 5. The range and mean values of QOL VAS at every week

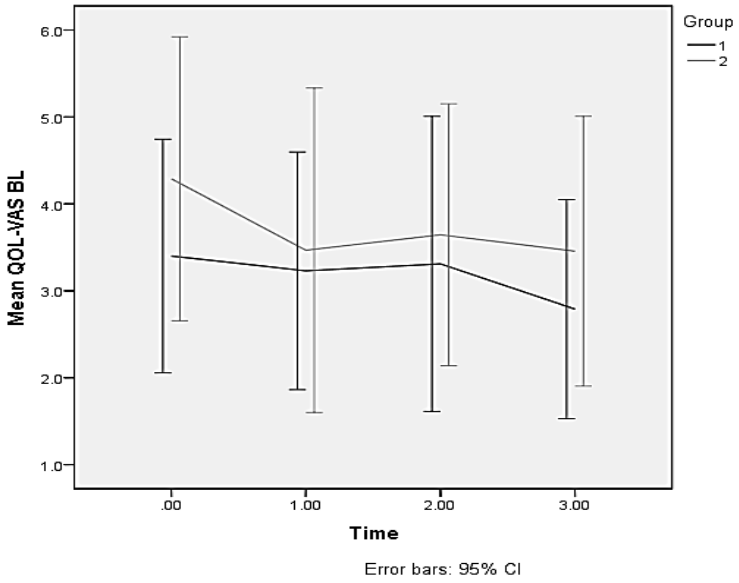


Table 6. The range and mean values of lameness in trot at every week

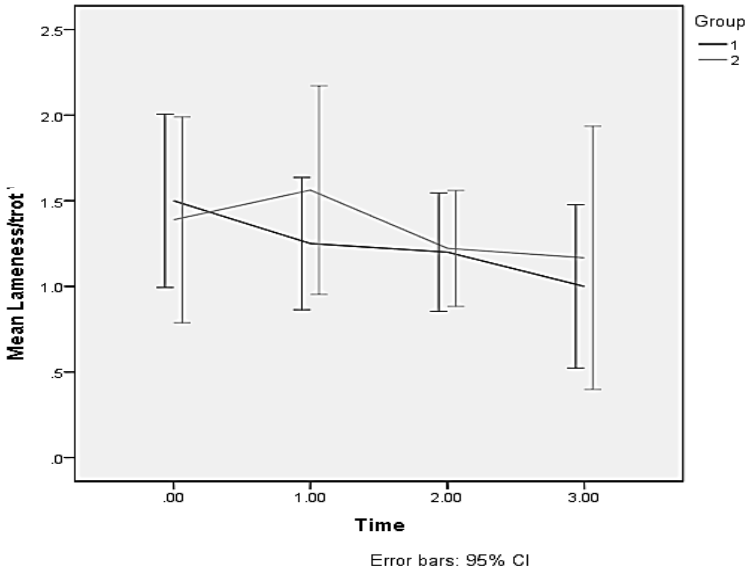


Table 7. The range and mean values of lameness in walk at every week

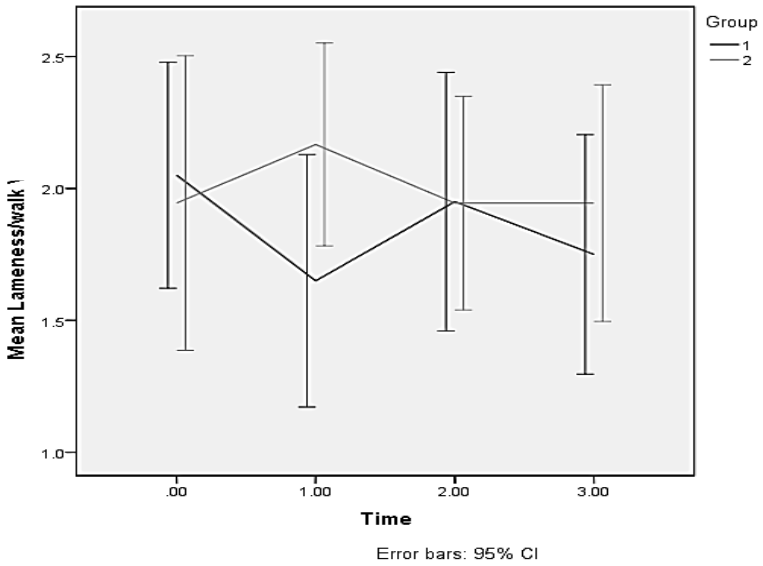
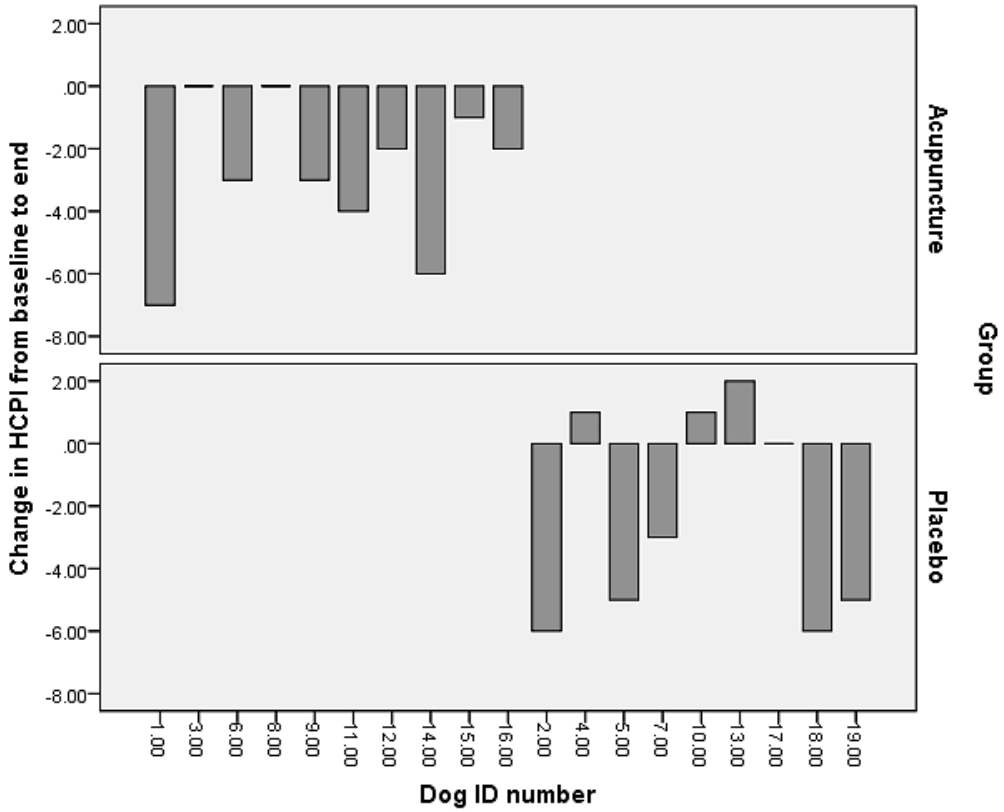


Table 8. The individual change in the HCPI from baseline (W_0) to the end (W_3)



The individual increases or decreases of the dogs' HCPI from W_0 to W_3 are presented in Table 8. 55,6 % of the dogs in the placebo group got better according to the HCPI and 33,3 % got worse. In the acupuncture group none of the dogs got worse during the study and 80 % got better.

There was no significant correlation of how well the owners guessed in which group their dogs belonged to (P=0.36). 70% of the owners in the acupuncture group guessed correctly the group in which their dogs belonged. In the placebo group 55,6% guessed correctly that their dog got no treatment and 45,4 % thought that their dogs received acupuncture. 60 % of the owners in the acupuncture group were pleased with the treatment effect and said that treatment met their expectations quite well. In the placebo group, the same answers were given by 33,3% of the owners. There was, however, no difference between the groups regarding the owners' satisfaction to the treatment effect (P=0.50) or how well the treatment met their expectations (P=0.40). 70% of the owners in the acupuncture group and 77,8% in the placebo group would recommend similar kind of study to someone familiar.

5 DISCUSSION

There was no significant difference between the acupuncture and the placebo group at any point during the study which shows that fine needle acupuncture doesn't have scientifically proved effect on chronic pain caused by CHD. There was, however, a significant difference in four variables in the acupuncture group when baseline was compared to last follow-up visit. Only one variable changed significantly in the placebo group. This shows that acupuncture might have positive effect on chronic pain even though there was no significant difference between the groups. Similar results are often seen in studies concerning so called alternative medicine (Hielm-Björkman et al. 2001, Hielm-Björkman et al. 2012), which acupuncture is also considered to be.

The results also indicate that acupuncture has a remarkable placebo effect even in a study where all evaluators are blinded, since nearly half of the owners in the placebo group thought that their dogs belonged to the acupuncture group. This was especially seen after the first treatment visit at W_1, because all the variables based on owners' assessment decreased at that point in both groups even though most of the dogs dropped the pain medication off during this time period. At W_2 and W_3 there was not so clear change in these variables in the placebo group. The locomotion VAS actually increased towards the end of the trial. This could be due to that the owners might be exited of this new treatment and participating in the trial and thus see their dogs more positively. They believe that their dogs receive treatment and they "want" to see their dogs better even though they are actually not. Dogs can also get cheerier when they get changes to their normal routines when they visit at the hospital and get attention there, so they might seem happier and thus less painful to the owners. At the beginning of the study the owners are also probably more enthusiastic and they could start to pay more attention to theirs dogs and thus evaluate them more or less pain compared to a normal situation. After the first excitement their expectations might decrease back to normal and they might not pay so much attention.

The sample size was quite small (nineteen dogs: ten in the acupuncture group and nine in the placebo group) which makes it more difficult to have results where there is significant difference between the groups. Especially, when we handle so called

alternative medicine, it is expected to have a milder effect on pain when compared to more studied medical treatments such as anti-inflammatory drugs. Pain is also always a subjective experience (Livingston 2010) so the evaluation changes greatly between observers and especially when done by untrained owners (Hielm-Björkman et al. 2011). We didn't train the owners at all at how to evaluate the dogs, only how to fill up the questionnaire. They marked how they really felt about the dogs' pain on their own opinion. Since the sample size was so small, we decided to use non-parametric tests in the statistical methods. According to the test of normality, parametric test could, however, have been used in other variables except lameness evaluation in trot and walk.

The study population also consisted of quite a heterogenic group of dogs. We had to include dogs with elbow dysplasia and geriatric dogs to the study which could interfere with the results. Younger dogs are expected to have better treatment result than older dogs with graver bone changes (Durkes 1994, Klitsgaard 1995, Jaeger et al. 2005). Lameness of older dogs with major bone changes might not improve even though the pain decreases, since the movement (ROM) of their joints are restricted and they have "learned to limb". Previous studies suggest using age as stratification factor when studying therapies aimed for CHD (Jaeger et al. 2005).

The locomotion assessment was done by veterinary students in present study. The results of lameness evaluation of a horse by veterinary interns have been reported to be less repeatable than by senior vets and there was no difference in the evaluation of the degree of lameness between these two groups (Keegan et al. 1998). It is therefore possible that the lameness evaluation by veterinary students is not a very reliable outcome measure.

Previous studies have reported significant placebo effect if acupuncture was conducted in non-acupuncture points (Gaw et al. 1975). Thus, in the present study, the dogs in the placebo group didn't receive any treatment or sham treatment that could interfere with the results. Hielm-Björkman et al. (2001) conducted a study of gold acupuncture where skin of the dogs was also pierced in the acupuncture group, which could also have an effect for the pain, even though done in non-acupuncture points and without gold wire. This should make the placebo effect milder.

We decided to compare the baseline (W_0) visit to W_3, not inclusion visit (W_{-1}) to W_3. Many of the dogs were still on pain medication at inclusion visit which could affect the

results. Owner also had more experience about how to fill in the questionnaire and they probably had also been observing their dogs more precisely than before the first visit. (Hielm-Björkman et al. 2009) also decided to use the baseline for the statistical analysis when testing the validity and sensitivity of HCPI, since owners probably answered more accurately the questionnaire then than at the first time. We noticed, that the HCPIs decreased in both groups between W_{-1} and W_0, which might be due to previously mentioned factors.

There was quite big size variation (18,8 to 55,4 kg's) between the dogs which could effect on the evaluation and measurements. Some dogs also suffered from other diseases that could interfere with the results. At least a dog in the acupuncture group had remarkably increased liver values and a dog in the placebo group was diagnosed with hypothyreosis during the study.

The use of rescue medication couldn't be calculated because it was zero at both baseline (W_0) and W_3. We told the owners to quit the use of pain medication in the beginning of the study, so the result would most likely have been different if inclusion visit was compared to W_3. On the other hand, owners wouldn't have used the medication so easily as normally because we advised to only use it in emergency. We also told them to quit the use of any joint supplements, such as oils, which could interfere with the results at the inclusion visit.

The normal variation in osteoarthritis signs resulting from other factors, such as weather and amount or intensity of exercise, might also result in an undulating curve of the variables. The study was conducted in the summer, when it is warmer. This can alleviate the dogs' pain signs, since it is generally accepted that dogs with hip dysplasia are often worse during cold weather and improve during warmer weather. The summer could thus make dogs in both groups feel better. Bodyweight didn't change in either of the groups, which tells that the dogs' didn't loose weight, which could have effected on the lameness positively.

VAS has been tested as valid and reliable, but it lacks good face validity (Hielm-Björkman et al. 2011). For owners, that haven't been trained to observe pain signs in their dogs, it isn't probably the most reliable assessment tool. (Hielm-Björkman et al. 2011) suggested that it can be used reliably, if the owners were first trained to notice pain signs by medicating the dogs suffering from chronic pain (caused by CHD) with

painkillers and then withdrawing the medication. Repeatability is also not very high in VAS at least when done by 4- week intervals (Hielm-Björkman et al. 2011). It might be more reliable when done in about 1-week interval, as in present study.

There was a quite obvious decrease in lameness in trot and walk at W_1 in the acupuncture group but an increase in the placebo group. This could be due to that the dogs had been taken of the pain medication and the dogs in the placebo group were actually lamer without medication while the dogs in the acupuncture group could have received help from the treatment.

If this study would be repeated I would try to choose more homogenic dogs, like dogs with only uni- or bilateral hip dysplasia that are about same age and size, for example only retrievers. The sample size should be increased also. Unfortunately the schedule was limited so we had to cope with the dogs that we had and were otherwise suitable for the study. The sample size was calculated by using statistical power of 80 and an α-error of 5% and it was supposed that similar study would also be done in Sweden and Brazil which would have made the sample size bigger if the studies would unite. The possible confounding factors in present study could be for example the honesty of answers, placebo effect and the use of rescues analgesics.

In summary, the results show that acupuncture cannot be said as effective treatment for chronic pain caused by CHD and OA, but it can ease the pain and locomotion difficulties. Further studies need to be conducted on this matter with more patients and with reliable assessment tools.

6 ACKNOWLEDGEMENTS

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8 APPENDIX

AKUPUNKTIOTUTKIMUSPOTILAAN SEURANTAKAAVAKE

Päiväys_____ Koiran nimi _____ Ikä _____ Sukup. _____

Virallinen nimi _____ Rekkari _____

Omistajan
nimi_____

Kaavakkeen täyttäjän
allekirjoitus_____

Koiran pääoireet:_____

Muistakaa että:

- Jokaiseen kysymykseen tulee laittaa yksi vastaus. (Ei enempää eikä vähempää.)
- Kysymyksiin tulee vastata joka kerta samalla lailla, eli arvioitte koiran vointia ajatellen aina samaa tilannetta. (Esim. jos olette aina vastanneet kysymyksiin arvioiden koiran vointia esim. pitkän lenkin jälkeen, tulee teidän jatkossakin verrata koiran vointia lenkin jälkeiseen tilanteeseen.)
- Jotta vastaukset ovat vertailukelpoisia, tulee saman henkilön vastata kysymyksiin joka kerta. Jos lomake on täytetty yhdessä, tulee se aina täyttää yhdessä.
- Merkatkaa ylös miten olette käyttäneet kipulääkkeitä sekä tähän lomakkeeseen että saamaanne kipulääkekalenteriin.
- Ilmoittakaa aina, jos koiranne vahingossa onkin saanut jotakin muuta hoitoa.

<u>Potilaan yleistila nyt</u>

Rastita yksi vaihtoehto / kysymys; se joka parhaiten vastaa koirasi tilaa **menneellä viikolla** (edellisen tutkimuskäynnin jälkeen).

1. Mielentila on:

erittäin virkeä	virkeä	ei virkeä, eikä apea	apea	erittäin apea
□	□	□	□	□

2. Koira heiluttaa häntäänsä:

hyvin usein	usein	silloin tällöin	harvoin	hyvin harvoin
□	□	□	□	□

3. Koira leikkii:

hyvin mielellään	mielellään	vastahakoisesti	hyvin vastahakoisesti	ei ollenkaa
□	□	□	□	□

4a. Koira kävelee:

hyvin mielellään	mielellään	vastahakoisesti	hyvin vastahakoisesti	ei ollenkaan
□	□	□	□	□

4b. Koira kävelee:

erittäin helposti	helposti	kohtalaisesti	vaikeasti	hyvin vaikeasti
□	□	□	□	□

5a. Koira ravaa (siirtää ristikkäistä etu- ja takajalkaa samanaikaisesti):

hyvin mielellään	mielellään	vastahakoisesti	hyvin vastahakoisesti	ei ollenkaan
□	□	□	□	□

5b. Koira ravaa (siirtää ristikkäistä etu- ja takajalkaa samanaikaisesti):

erittäin helposti	helposti	kohtalaisesti	vaikeasti	hyvin vaikeasti
□	□	□	□	□

6. Koira peitsaa (siirtää samanpuoleista etu- ja takajalkaa samanaikaisesti):

hyvin harvoin	harvoin	silloin tällöin	usein	hyvin usein
□	□	□	□	□

7a. Koira laukkaa:

hyvin mielellään	mielellään	vastahakoisesti	hyvin vastahakoisesti	ei ollenkaan
□	□	□	□	□

7b. Koira laukkaa:

erittäin helposti	helposti	kohtalaisesti	vaikeasti	hyvin vaikeasti
□	□	□	□	□

8. Koiran tapa laukata muistuttaa takaa jänistä: molemmat takajalat liikkuvat yhdessä

hyvin harvoin	harvoin	silloin tällöin	usein	hyvin usein
□	□	□	□	□

9. Koira liikkuu oma-aloitteisesti ulkona:

hyvin mielellään	mielellään	vastahakoisesti	hyvin vastahakoisesti	ei ollenkaan
□	□	□	□	□

10. Koira liikkuu pidemmän levon jälkeen:

erittäin helposti	helposti	kohtalaisesti	vaikeasti	hyvin vaikeasti
□	□	□	□	□

11a. Koira hyppää (esim. sohvaan, autoon tms.):

hyvin mielellään	mielellään	vastahakoisesti	hyvin vastahakoisesti	ei ollenkaan
□	□	□	□	□

11b. Koira hyppää (esim. sohvaan, autoon tms.):

erittäin helposti	helposti	vaikeasti	erittäin vaikeasti	ei ollenkaan
□	□	□	□	□

12. Koira kulkee rappusia ylös:

hyvin mielellään	mielellään	vastahakoisesti	hyvin vastahakoisesti	ei ollenkaan
□	□	□	□	□

13. Koira kulkee rappusia alas:

hyvin mielellään	mielellään	vastahakoisesti	hyvin vastahakoisesti	ei ollenkaan
□	□	□	□	□

14. Koira menee makuulle:

erittäin helposti	helposti	kohtalaisesti	vaikeasti	hyvin vaikeasti
□	□	□	□	□

15. Koira nousee makuulta:

erittäin helposti	helposti	kohtalaisesti	vaikeasti	hyvin vaikeasti
□	□	□	□	□

16. Koira läähättää kivun vuoksi:

ei juuri koskaan	harvoin	joskus	usein	hyvin usein
□	□	□	□	□

17. Koira valittaa kipuja:

ei juuri koskaan	harvoin	joskus	usein	hyvin usein
□	□	□	□	□

18. Koira valittaa kun takajalkoja venytetään taakse:

ei juuri koskaan	harvoin	joskus	usein	hyvin usein
□	□	□	□	□

19. Koira liikkuu kovan rasituksen jälkeen:

erittäin helposti	helposti	kohtalaisesti	vaikeasti	hyvin vaikeasti
□	□	□	□	□

Koiran liikuntavaikeudet

Arvioi koiran liikkumavaikeus piirtämällä rasti alla olevalle janalle, siihen missä se parhaiten kuvaa tämänhetkisen tilanteen:

Ei mitään vaikeuksia _____ Pahin mahdollinen tilanne

Koiran elämänlaatu

Arvioi koiran elämänlaatua piirtämällä rasti alla olevalle janalle, siihen missä se parhaiten kuvaa tämänhetkisen tilanteen:

Paras mahdollinen _____ Pahin mahdollinen

Kun täytitte yllä olevat kysymykset, millaista todellista kiputilaa arvioisitte että vastauksenne vastaavat:

□ Vastaukset vastaavat tosi tilannetta, sillä koira ei ole syönyt kipulääkettä ollenkaan tai se syö niitä hyvin harvoin ja nytkin siitä on ainakin yli 3 vrk aikaa

□ Vastaukset saattavat osoittaa että koiran tila ehkä on hieman parempi kuin se olisi ilman mitään kipulääkettä, sillä se on ajoittain saanut kipulääkitystä

□ Vastaukset eivät välttämättä vastaa koiran todellista normaalia kiputilaa ollenkaan. Ne osoittavat todennäköisesti että koira on paremmassa kunnossa, sillä se on saanut kipulääkettä useasti

Onko koira saanut kipulääkettä edellisen tutkimuskäynnin jälkeen?

□ Ei

□ Kyllä, edellisen kerran_____ tuntia /vrk sitten

Kipulääkkeen nimi:_____

Viime viikon kipulääkitykset:

Pvm ___: _____ antokertaa
Pvm ___: _____ antokertaa
Pvm ___: _____ antokertaa
Pvm ___: _____ antokertaa
Pvm ___: _____ antokertaa
Pvm ___: _____ antokertaa
Pvm ___: _____ antokertaa

eli viikon aikana:

0 päivänä	1 päivänä	2-3 päivänä	4-5 päivänä	6-7 päivänä
□	□	□	□	□

Muu kipuhoito edellisen viikon aikana:

_____

_____

_____

Koiran muu lääkitys:

_____

_____

VERTAILEVA KYSELY

Seuravat kysymykset ovat vertailevia. Vertaatte koiranne nykytilaa siihen miten koira oli ennen toista tutkimuskäyntiä (eli ensimmäistä hoito-/lumekäyntiä):

Onko koiranne

	paljon parempi	vähän parempi	saman-lainen	vähän huonompi	paljon huonompi
Liikkuminen	☐	☐	☐	☐	☐
Rappusia ylös	☐	☐	☐	☐	☐
Rappusia alas	☐	☐	☐	☐	☐
Maaten alas	☐	☐	☐	☐	☐
Nousee ylös	☐	☐	☐	☐	☐
Ylöspäin kiipeily	☐	☐	☐	☐	☐
Hyppääminen	☐	☐	☐	☐	☐
Kävely	☐	☐	☐	☐	☐
Ravi	☐	☐	☐	☐	☐
Laukka	☐	☐	☐	☐	☐
Peitsaaminen	☐	☐	☐	☐	☐
Pupu-laukka	☐	☐	☐	☐	☐
Oma-aloitteinen liikkuminen	☐	☐	☐	☐	☐
Tilanteita:					
Levon jälkeen	☐	☐	☐	☐	☐
Kovan rasituksen jälkeen	☐	☐	☐	☐	☐
Rasitus + lepo, jälkeen	☐	☐	☐	☐	☐
Kipu - yleensä	☐	☐	☐	☐	☐
Kipu takajalkoja venyttäessä	☐	☐	☐	☐	☐
Läähättäminen	☐	☐	☐	☐	☐
Valittaminen kivusta	☐	☐	☐	☐	☐
Mielentila	☐	☐	☐	☐	☐
Sosiaalisuus	☐	☐	☐	☐	☐
Leikkisyys	☐	☐	☐	☐	☐
Elämänlaatu	☐	☐	☐	☐	☐
Turkki ja iho					
Turkin kiilto	☐	☐	☐	☐	☐
Turkin pehmeys	☐	☐	☐	☐	☐
Turkin tuuheus	☐	☐	☐	☐	☐
Ihon kunto	☐	☐	☐	☐	☐

Tällä kaavakkeella seurataan koirien yleistä hyvinvointia. Olkaa hyvä ja vastatkaa näihinkin kysymyksiin.

1. Ruokahalu on edellisen kuukauden aikana ollut:

erittäin hyvä	hyvä	tyydyttävä	huono	erittäin huono
□	□	□	□	□

2. Koira on edellisen kuukauden aikana oksennellut:

0 kertaa / kk	1-2 kertaa / kk	1 x / viikko	3-5 x / viikko	melkein päivittäin
□	□	□	□	□

3. Koira on edellisen kuukauden aikana ripuloinut:

0 kertaa / kk	1-2 kertaa / kk	1 x / viikko	3-5 x / viikko	melkein päivittäin
□	□	□	□	□

4. Koiralle on edellisen kuukauden aikana noussut iho-oireita ja/tai kutinaa

0 kertaa / kk	1-2 kertaa / kk	1 x / viikko	3-5 x / viikko	melkein päivittäin
□	□	□	□	□

5. Koira on edellisen kuukauden aikana saanut yleiskuntoon, niveliin tai lihaksiin vaikuttavia ravintolisiä

0 kertaa / kk	1-2 kertaa / kk	1 x / viikko	3-5 x / viikko	melkein päivittäin
□	□	□	□	□

Mitä ja miten usein _____
_____
_____

Muuta kommenttia:
_____
_____
_____
_____

Hoitovaste

Hoitotulokseen olen tähän asti:

Erittäin tyytyväinen	Tyytyväinen	En osaa sanoa	Tyytymätön	Erittäin tyytymätön
□	□	□	□	□

Hoitotulos on vastannut odotuksiani:

Täysin	Melko hyvin	Osittain	Melko vähän	Ei ollenkaan
□	□	□	□	□

Luulen että koirani sai:

Akupunktiohoitoa	Lumehoitoa
□	□

Perustelut: (mitkä asiat ovat nyt paremmat tai huonommat)

_____
_____
_____
_____

Mitä tuotteita (ravintolisiä, lääkkeitä ym.) olette antaneet koirallenne ennen tutkimusta ja lakanneet antamasta tutkimuksen ajaksi?

_____
_____
_____

Koetteko tarvitsevanne edellä mainittuja tuotteita enää?

□ Kyllä □ Ei

Oletteko toimineet koiranne kanssa jotenkin eri tavalla tutkimuksen aikana? (esim. liikunnan muutos, ruokinnan muutos/ koiran laihdutus, muutto…)

_____
_____
_____

Onko koirallanne mielestänne □ alhainen kipukynnys
□ korkea kipukynnys

Onko teillä mielestänne □ alhainen kipukynnys
□ korkea kipukynnys

Tutkimuspalaute:

Jos teillä olisi toinen koira, jolla on samanlaisia oireita, kuin tutkimuksessa mukana olleella koiralla, osallistuisitteko uudelleen samanlaiseen tutkimukseen?

Hyvin todennäköisesti	Todennäköisesti	En osaa sanoa	Epätodennäköisesti	Hyvin epätodennäköisesti
□	□	□	□	□

Jos ystävällänne tai sukulaisellanne olisi koira, jolla on sama ongelma, suosittelisitteko akupunktiohoitoon osallistumista?

Hyvin todennäköisesti	Todennäköisesti	En osaa sanoa	Epätodennäköisesti	Hyvin epätodennäköisesti
□	□	□	□	□

Mitä hyvää ja huonoa tutkimuksessa ja sen järjestelyissä oli?

_____
_____
_____
_____
_____
_____

Muu palaute:

_____
_____
_____
_____
_____

KIITOKSIA VAIVANNÄÖSTÄ!